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Sheridon et al.

[11] **Patent Number:** 5,767,826[45] **Date of Patent:** Jun. 16, 1998[54] **SUBTRACTIVE COLOR TWISTING BALL DISPLAY**[75] Inventors: **Nicholas K. Sheridan**, Los Altos;
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both of Calif.[73] Assignee: **Xerox Corporation**, Stamford, Conn.[21] Appl. No.: **572,780**[22] Filed: **Dec. 15, 1995**[51] Int. Cl.⁶ **G06F 9/32; G02F 1/13**[52] U.S. Cl. **345/84; 345/107; 359/296**[58] Field of Search **345/84, 85, 107,**
345/108, 4, 6, 87; 359/296; 349/80[56] **References Cited****U.S. PATENT DOCUMENTS**

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A multilayer substrate material for a subtractive-color electrical twisting ball display. The material is composed of a layered substrate including first, second, and third layers, each layer of the substrate being a nearest neighboring layer with respect to at least one other layer and no more than two other layers. Spheroidal balls are disposed in each of the first, second, and third layers. In the first layer, each ball has at least two component regions including a component region having a first chromatic color, such as transparent cyan. In the second layer, each ball has at least two component regions including a component region having a second chromatic color, such as transparent magenta. In the third layer, each ball has at least two component regions including a component region having a third chromatic color, such as transparent yellow. Optionally, the substrate can further include a fourth layer in which are disposed spheroidal balls, each having at least two component regions including a black component region. Each ball in each layer has an anisotropy for providing an electrical dipole moment, the electrical dipole moment rendering the ball electrically responsive such that when the ball is rotatably disposed in a nonoscillating electric field while the electrical dipole moment of the ball is provided, the ball tends to rotate to an orientation in which the electrical dipole moment aligns with the field. Also disclosed are a twisting-ball apparatus made with the material, and a method for using this apparatus.

24 Claims, 32 Drawing Sheets